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(54) Title: METHOD AND COMPOSITION FOR DISINFECTING AND SOLIDIFYING LIQUID WASTE (57) Abstract The method of disinfecting and solidifying an aqueous waste containing microorganisms is provided in which dry glutaraldehyde is used as the disinfectant. In preparing the product for use in the method dry glutaraldehyde is mixed with a superabsorbant to partially transfer an aqueous solution from the dry glutaraldehyde to the superabsorbant.		

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**METHOD AND COMPOSITION FOR DISINFECTING
AND SOLIDIFYING LIQUID WASTE**

5

FIELD OF INVENTION

The field of this invention is the treatment
10 of liquid wastes to improve the convenience and safety
of their disposability. In particular this invention is
concerned with the use of compositions to solidifying
and/or disinfect hospital wastes such as blood and body
fluids resulting from surgery, and medical laboratory
15 wastes, all of which are potentially infectious.

BACKGROUND OF INVENTION

The class of materials known as
superabsorbents have been used for converting liquid
20 medical wastes into a gelled or solidified form for
disposal. A granular superabsorbent is added to the
medical waste, which may be an inadvertent spill or a
containerized waste, such as blood or body fluids.

Superabsorbents are polymers which are
25 characterized by their capacity to imbibe water. As the
water is absorbed, the superabsorbent swells with a
great increase in volume and forms a gel-like material.
This class of superabsorbents has been defined as
polymers capable of at least a tenfold absorption of
30 aqueous fluid. Two well known kinds of such polymers

-2-

are the polyacrylates, such as sodium or potassium polyacrylate, and starch-based superabsorbents that comprise starch acrylonitrile graft polymers.

For disinfecting and gelling medical wastes, antimicrobial agents have been used in combination with the superabsorbents. However, a number of practical problems have been encountered in the use of such absorbent/disinfectant mixtures. It is desired to gel the liquid waste while at the same time effectively disinfecting the gelled body throughout its mass. Heretofore, these combined objectives have not been adequately achieved. The efforts of prior inventors are illustrated by United States Patent Nos. 4,748,069, 4,749,600, 4,816,307, and 4,900,500, and published European application 0440962A2.

When a mixture of a disinfectant powder and a granular absorbent is added to a containerized liquid waste it settles to the bottom before the gellation takes place. The superabsorbent granules then swell and distribute upwardly until the entire liquid is converted to gel form. However, the disinfectant tends to stay in the bottom portion of the container and is not effectively distributed throughout its upper portions. The resulting gelled body, consequently, has an uneven distribution of the disinfectant.

-3-

SUMMARY OF INVENTION

The present invention comprises a novel method and composition for disinfecting and solidifying liquid medical wastes. The method and composition are particularly adapted for use with containerized wastes, such as the blood or other body fluids collected in suction canisters during surgical procedures, liquid containerized and other containerized wastes which may contain harmful microorganisms, and medical laboratory wastes. The composition can also be used for hospital application to medical wastes which have spilled on hospital surfaces such as floors and counters. Veterinary medical uses are also envisioned. The method and composition of the invention can be used to sanitize, disinfect and sterilize liquid waste that may contain potential pathogens (bacterial, viral, fungal and parasitic). The invention can also be used to control or reduce odors produced in liquid waste by micro-organisms.

This invention provides improvements over the prior art methods of disinfecting and solidifying aqueous liquid medical wastes. An important feature of the invention is the use of a glutaraldehyde source material which consists essentially of particles of a non-swelling absorbent that has been impregnated with a

-4-

concentrated aqueous solution of glutaraldehyde. The particles of this source material are externally dry and free-flowing, and can be mixed with a granular superabsorbent. During the mixing a significant
5 interaction occurs.

By mixing together the dry glutaraldehyde source material and a superabsorbent polymer, the glutaraldehyde source material is brought into intimate contact with the superabsorbent. Although the
10 glutaraldehyde and water are tenaciously retained in carrier desiccant particles, the water absorbency of the superabsorbent granules results in a partial transfer of the glutaraldehyde solution. Moreover, this transfer of glutaraldehyde can be carried out without swelling the
15 superabsorbent granules to a non-free-flowing condition. The resulting mixture can be added to the top of a containerized quantity of a liquid waste, such as a surgical or medical laboratory waste, to overcome the poor distribution problem described above. Although the
20 mixture does drop to the lower portion of the container, because of the pre-transfer of the glutaraldehyde to the superabsorbent granules, the disinfectant is effectively distributed in association with the expanding and gelling superabsorbent.

-5-

DETAILED DESCRIPTION

Glutaraldehyde is an amber liquid at room temperature. It is soluble in water and alcohols. The present invention, does not directly utilize a solution of glutaraldehyde. Rather, a glutaraldehyde source material is obtained or prepared which consists essentially of particles of a non-swelling desiccant which have been impregnated with a concentrated aqueous solution of glutaraldehyde. The desiccant particles externally remain free-flowing. By way of specific example, an impregnated desiccant product is sold commercially as a "dry glutaraldehyde" by Thetford Corporation, Ann Arbor, Michigan. This product is understood to contain, on a weight basis, approximately 31% glutaraldehyde, 31% water, and 38% desiccant (amorphous silicon dioxide). Desiccants suitable for use in preparing dry glutaraldehyde can be obtained from commercial sources. For example, the "Syloid" amorphous silicas of W.R. Grace & Co., Baltimore, Maryland, can be used. These products are supplied in the form of powders having a high degree of water absorbancy. In preparing a dry glutaraldehyde, the desiccant particles after impregnation can be formed into granular aggregates. The dry glutaraldehyde product of Thetford, referred to above, is in the form of granular aggregates

-6-

of 0.5 to 4 mm diameter. Other silica-based desiccants are available commercially, such as the calcium silicate product of J.M. Huber Corp., Harve de Grace, Maryland, sold under the name "Hubersorb". Suitable desiccants
5 are typically amorphous forms of silica which are microporous and have high water absorbancy due to capillary action.

The superabsorbent is used in the form of dry free-flowing granules. Such products are available
10 commercially from a number of sources. One preferred superabsorbent is the potassium polyacrylate superabsorbent sold by Chemdal Corp., Palatine, Illinois, as "Aridall 1440". This product is readily water-wetable, and quickly forms a gel on absorbing
15 water. Polyacrylate polymer superabsorbent can also be used in the sodium form, such as the "Aridall 1465" of Chemdal Corp. or "Water Lock" J-550 sodium polyacrylate of Grain Processing Corp., Muscatine, Iowa. Other usable superabsorbents include starch-polyacrylonitrile
20 graft copolymers. For example a starch graft copolymer is sold under the name "Sta-Wet" by Polysorb, Inc., Coeur d'Alene, ID. Chemically this produce is starch-g-poly (acrylamide-co-potassium acrylate). These polymers can be in the form of their sodium or other
25 alkali metal salts, and are further described in U.S.

-7-

Patents 3,661,815 and 4,302,369. Another usable superabsorbent is sold as "Water Lock" G-400 by Grain Processing Corp. This polymer chemically is understood to be the sodium salt of

5 poly(2-propenamide-co-2-propenoic acid). Sodium carboxymethyl cellulose may be modified by aluminum cross-linking to provide a gelling superabsorbent, such as the "AQU-D3236 or D3273" aluminum crosslinked sodium carboxymethyl cellulose products sold by Aqualon,
10 Wilmington, DE.

In preparing the composition of this invention, the desiccant containing the glutaraldehyde is mixed with the granular superabsorbent under conditions resulting in part of the glutaraldehyde being
15 transferred to the superabsorbent. The relative proportions of the ingredients are of importance. Excessive amounts of the glutaraldehyde source material may result in the transfer of so much water that the superabsorbent granules become sticky and non-free
20 flowing. If too little glutaraldehyde material is present, there will be an insufficient transfer of the glutaraldehyde. In general, from about 50 to 300 parts by weight of the glutaraldehyde source material can be mixed per 100 parts of the superabsorbent while
25 achieving the desired results. Preferred proportions

-8-

are from 100 to 200 parts by weight of the glutaraldehyde material per 100 parts of the absorbent polymer. For example, in a specific embodiment, 3 parts of the dry glutaraldehyde are mixed with 2 parts of the
5 polymer.

In carrying out the transfer of glutaraldehyde to the granules of the superabsorbent it is important, as indicated above, to avoid swelling of the superabsorbent free-flowing granular and/or powder
10 mixture. The mixture should not be so sticky that it is not free-flowing. The mixture should remain free-flowing. Within the proportions described, and depending on the kind and extent of mixing, the amount of water transferred with the glutaraldehyde can be
15 limited so that it does not cause the absorbent granules to become non-free-flowing. It is preferred to have the desiccant carrier impregnated with a concentrated aqueous solution of glutaraldehyde. For example, a 50% aqueous solution can be used, or, more generally, a
20 solution of from 25 to 75% glutaraldehyde can be used for the impregnation.

When the glutaraldehyde source material is obtained in the form of granular aggregates, it can be partially or even completely broken down to powder form
25 comprising individual particles. The particle powder

-9-

form can assist the contacting. Preferably, however, the granular aggregate material, such as the dry glutaraldehyde supplied by Thetford, is initially processed so that only part of the granules are reduced to a powder. This mixed granule/powder substrate is especially desirable for the controlled transfer contacting.

It has also been found advantageous to add a small amount of non-impregnated, non-swelling desiccant powder in the initial processing of the glutaraldehyde source material. For example, 1 part by weight of a desiccant powder can be mixed with from 40 to 100 parts of the dry glutaraldehyde. For example, in a preferred embodiment, 1 part of an amorphous calcium silicate desiccant is mixed per 60 to 70 parts of the dry glutaraldehyde. Other silicate or silica desiccants can be substituted, such as those described above for absorbing the aqueous solutions of glutaraldehyde.

In the pre-mixing of the glutaraldehyde granules, the added desiccant powder acts as a blending agent. Any moisture released from the glutaraldehyde material can be absorbed by the added desiccant. The initial glutaraldehyde/desiccant mixture can be stored for a short time to allow equilibration to occur. The presence of the added desiccant in the premix also tends

-10-

to assure that the ingredients remain free-flowing during the transfer of the glutaraldehyde solution.

The use of this invention in a presently preferred embodiment is illustrated by the following operational example. It should be understood, however, that modifications and substitutions can be made without departing from the scope of this invention.

OPERATIONAL EXAMPLE

To prepare a disinfecting and gelling composition for treatment of aqueous medical wastes, three ingredients are employed:

1) Granular aggregates of dry glutaraldehyde, Thetford Corporation, Ann Arbor, Michigan, (approximately 31% glutaraldehyde, 31% water, and 38% amorphous SiO_2 desiccant). The granules have a size distribution from 0.5 to 4 mm corresponding to a screen size of 6 to 30 mesh.

2) Superabsorbent granules comprising potassium or sodium polyacrylate, Chemdal Corp., trademarked respectively "Aridall 1440" and "Aridall 1465". The granules have a size distribution from 200 to 850 microns. The polyacrylate granules have been surface-treated with a polyquaternary amine to improve water-wetability.

-11-

3) The calcium silica desiccant sold as "Hubersorb 600", by J.M. Huber Corp. (average particle size 3.2 microns), or other similar non-swelling desiccant.

5 The foregoing ingredients are used in the following weight portions: 66% dry glutaraldehyde, 1% silicate desiccant, and 33% polyacrylate absorbent. The combining of the ingredient is carried out in a ribbon blender. The dry glutaraldehyde and the desiccant are
10 first charged to the blender, which is rotated for 15 minutes in each direction. Preferably but not necessarily, the mixing is interrupted to remove a glutaraldehyde/desiccant pre-mix, which is stored in closed drums for several hours, viz. overnight or for 24
15 hours.

 The acrylate polymer is introduced into the blender and the pre-mix of dry glutaraldehyde and desiccant is spread over the top of the polymer granules. The blender is then rotated for 15 minutes in
20 each direction. In the first mixing operation, the dry glutaraldehyde aggregates have been partially reduced to a powder. In the second blending, the particles and remaining granules are brought into intimate contact with the acrylate polymer granules. Transfer of the
25 glutaraldehyde can be visually observed by the

-12-

appearance of a yellowish color associated with the previously white acrylate granules. Over-mixing should be avoided since it may generate heat and cause excessive transfer of moisture to the acrylate powder and granules. After a homogeneous mixture is obtained, the mixing is terminated. Optionally, if desired, a perfume may be added during the final mixing operation to mask the glutaraldehyde odor. For example 0.5% of a spray dried perfume can be used.

10 The product is ready for packaging and use. One ounce of the product can solidify and disinfect up to about 1500 milliliters of liquid waste, i.e. one part powder solidifies about fifty parts liquid (w/v). For example, a one ounce pre-measured quantity can be added to a liquid waste in a 1500 ml suction canister. Most of the mix will fall to the lower portion of the container, and then the liquid waste will be rapidly converted to a gelled body by the expansion of the polymer granules, which proceeds from the bottom to the top of the container. The glutaraldehyde disinfectant is distributed throughout the mass of the gelled body for effectively disinfecting the entire body. This distribution can be observed by the yellow color of the gelled material.

25 The disinfecting and gelling composition

-13-

produced as described in this example is stable in storage. It remains free flowing despite the residual water in the dry glutaraldehyde material. In use, however, the glutaraldehyde remaining associated with

5 the desiccant carrier is available for supplemental disinfection by diffusion into the aqueous medical waste. This product is useful for solidifying and disinfecting human and animal wastes resulting for medical or veterinary procedures and laboratory

10 tests.

-14-

CLAIMS

1. A method of disinfecting and solidifying an aqueous liquid waste containing microorganisms in which a solid particulate mixture of a disinfectant and
5 a superabsorbent is added to the waste, wherein the improvement comprises:

(a) using a glutaraldehyde source material which consists of particles of a non-swelling absorbent which have been impregnated with an aqueous solution of
10 glutaraldehyde, said particles externally being dry and free-flowing;

(b) mixing said glutaraldehyde source material with a free-flowing granular superabsorbent capable of forming a gel by absorbing water, from 50 to
15 300 parts by weight of said glutaraldehyde source material being used per 100 parts of said superabsorbent, said mixing bringing the particles of the said glutaraldehyde source material into intimate contact with the superabsorbent granules and
20 transferring part of the glutaraldehyde solution from said particles to said granules without swelling the granules to a non-free flowing condition; and

(c) adding the resulting mixture to the top of a containerized quantity of a liquid waste, said
25 mixture first dropping to the lower portion of said

-15-

container and thereafter converting the liquid waste to a gelled body with glutaraldehyde disinfectant distributed throughout.

2. The method of claim 1 in which said
5 glutaraldehyde source material comprises particles of a silica absorbent containing the glutaraldehyde solution.

3. The method of claim 1 in which said superabsorbent is a polyacrylate polymer.

4. The method of claim 1 in which from 100
10 to 200 parts by weight of the glutaraldehyde source material are mixed with each 100 parts of said superabsorbent.

5. The method of disinfecting and solidifying an aqueous liquid waste containing
15 microorganisms in which a solid particulate mixture of a disinfectant and a superabsorbent is added to the waste, wherein the improvement comprises:

(a) using a glutaraldehyde source material which consists of particles of a silica desiccant which
20 has been impregnated with an aqueous solution of glutaraldehyde, said particles externally being dry and free-flowing;

(b) mixing said glutaraldehyde source material with a free-flowing granular polyacrylate
25 polymer capable of forming a gel by absorbing water,

-16-

from 100 to 200 parts by weight of said glutaraldehyde source material being used per each 100 parts of said polymer, said mixing bringing the particles of the said source material into intimate contact with the polymer granules and transferring part of the glutaraldehyde solution from said desiccant to said polymer without swelling the granules to a non-free-flowing condition; and

(c) adding the resulting mixture to the top of a containerized quantity of a liquid waste, said mixture first dropping to the lower portion of said container and thereafter converting the liquid waste to a gelled body with glutaraldehyde disinfectant distributed throughout.

6. A method of preparing a composition for addition to liquid wastes, comprising:

(a) using a glutaraldehyde source material which consists of particles of a non-swelling absorbent which have been impregnated with an aqueous solution of glutaraldehyde, said particles externally being dry and free-flowing; and

(b) mixing said glutaraldehyde source material with a free-flowing granular superabsorbent capable of forming a gel by absorbing water, from 50 to 300 parts by weight of said glutaraldehyde source

-17-

material being used per 100 parts of said
superabsorbent, said mixing bringing the particles of
the said glutaraldehyde source material into intimate
contact with the superabsorbent granules and

5 transferring part of the glutaraldehyde solution from
said particles to said granules without swelling the
granules to a non-free-flowing condition.

7. The method of claim 6 in which said
glutaraldehyde source material comprises particles of a
10 silica desiccant which has been impregnated with the
aqueous solution of glutaraldehyde, said impregnating
solution having a concentration of from 25 to 75%
glutaraldehyde.

8. The method of claim 6 in which said
15 superabsorbent is a sodium or potassium polyacrylate
polymer.

9. The method of claim 6 in which from 100
to 200 parts by weight of the glutaraldehyde source
material are mixed with each 100 parts of said
20 superabsorbent.

10. A method of preparing a composition for
addition to liquid wastes, comprising:

(a) using a glutaraldehyde source material
which consists of particles of a silica desiccant which
25 have been impregnated with an aqueous solution of

-18-

glutaraldehyde, said particles externally being dry and free-flowing;

(b) mixing said glutaraldehyde source material with a free-flowing granular polyacrylate polymer superabsorbent capable of forming a gel by absorbing water, from 100 to 200 parts by weight of said glutaraldehyde source material being used per each 100 parts of said superabsorbent, said mixing bringing the particles of the said glutaraldehyde source material into intimate contact with the superabsorbent granules and transferring part of the glutaraldehyde solution from said desiccant particles to said granules without swelling the granules to a non-free flowing condition.

11. The disinfecting and gelling composition prepared by the method of claims 6, 7, 8, 9 or 10.

12. A method of preparing a disinfecting and gelling composition for treatment of aqueous wastes, comprising the steps of:

(a) using a glutaraldehyde source material in the form of aggregates of a particulate non-swelling absorbent which has been impregnated with an aqueous solution of glutaraldehyde;

(b) mechanically manipulating the glutaraldehyde source material to partially reduce the aggregates to a powder in the presence of an added

-19-

non-swelling desiccant;

(c) mixing the resulting mix with a granular superabsorbent polymer capable of forming a gel by absorbing water, from 50 to 300 parts by weight of said glutaraldehyde powder being used per 100 parts of said superabsorbent polymer, said mixing bringing the glutaraldehyde containing powder and granules into intimate contact with the superabsorbent granules and transferring glutaraldehyde solution to the superabsorbent granules.

13. The method of claim 12 in which said glutaraldehyde source material comprises particles of a silica desiccant which has been impregnated with an aqueous solution of glutaraldehyde, said superabsorbent polymer being composed of potassium polyacrylate, and said aqueous solution having a glutaraldehyde concentration of 25 to 75%.

14. The method of claim 1 in which from 100 to 200 parts by weight of the glutaraldehyde source material are mixed with each 100 parts of said superabsorbent.

15. The method of claim 12 in which said added desiccant is used in an amount of from 1 part by weight per 60 to 70 parts of said glutaraldehyde source material.

-20-

16. The disinfecting and gelling composition prepared by the method of claims 12, 13, 14 or 15.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/13376

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : Please See Extra Sheet.

US CL : Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : U.S. : 422/1, 28, 36; 588/255, 258; 604/317; 523/122; 424/76.5, 76.3, 409; 514/705

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 4,122,192 (FELLOWS) 24 October 1978, abstract, column 1, line 46 to column 2, line 38, column 3, line 52 to column 4, line 4 and column 5, lines 5-30.	6-16
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Y	US, A, 4,816,307 (HONEYCUTT) 28 March 1989, abstract, column 1, line 49 to column 2, line 42 and Example, column 4.	1-16
Y		1-16
Y	US, A, 5,092,858 (BENSON ET AL.) 03 March 1992, abstract, columns 1-2 and column 3, lines 29-55.	1-16

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/13376

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US, A, 5,158,778 (DONOVAN ET AL.) 27 October 1992, abstract, column 2, line 42 to column 4, line 14, column 8, line 56 to column 10, line 10, column 10, line 50 to column 12, line 4 and column 13, lines 3-69.	6-16 ----- 1-16

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER:

IPC (6):

IPC (6): A61L 2/00, 2/16; C08J 3/20; C08K 5/07, 7/26; A01N 25/14, 35/02

US CL :

A. CLASSIFICATION OF SUBJECT MATTER:

US CL :

U.S. : 422/1, 28, 36; 588/255, 258; 604/317; 523/122; 424/76.5, 76.3, 409; 514/705

B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

APS

Search terms; glutaraldehyde, deoxyglutaraldehyde, glutaric and aldehyde, pentanedialdehyde, absorbent, superabsorbent, polymer, impregnates, soak, encapsulate; silica.